

# Introduction to the Near Detector Concept Study

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# 1. Context

# DUNE

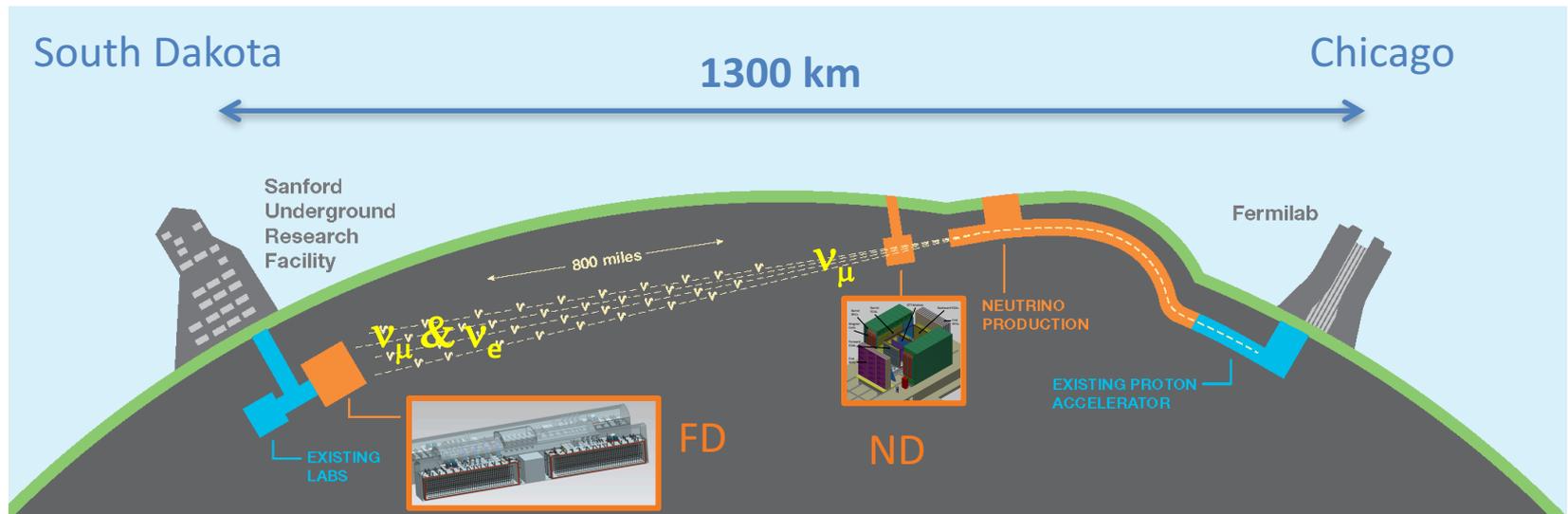
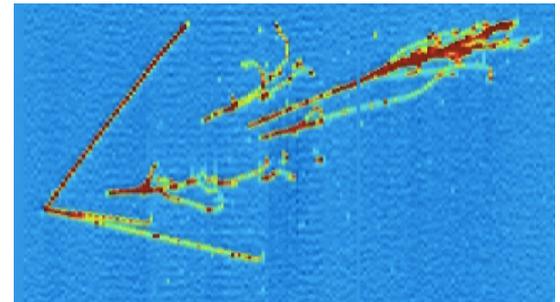
- **DUNE Scope**

- **Four 10-kt LAr-TPC Far Detector (FD) modules**

- Modules #1 and #2: CD-2/3 review in 2019
    - Modules #3 and #4: approval early 2020s

- **DUNE Near Detector (ND)**

- CD-2 review in 2019 (CDR)
    - CD-3 review in 2020 (TDR)



# DUNE: International from day one

- **US-hosted – but truly international**
- **Model for international partnerships:**
  - LBNF/DUNE developed as an international partnership
  - Governance model follows closely that of the LHC:
    - **Facility:** LHC ↔ LBNF
    - **Experiment:** ATLAS/CMS ↔ DUNE
- **International Funding Model:**
  - LBNF: **US-hosted project with international contributions**  
(aim: ~75% US, ~25% non US)
  - DUNE: an **international science collaboration**  
(aim: ~25% US, ~75% non-US)

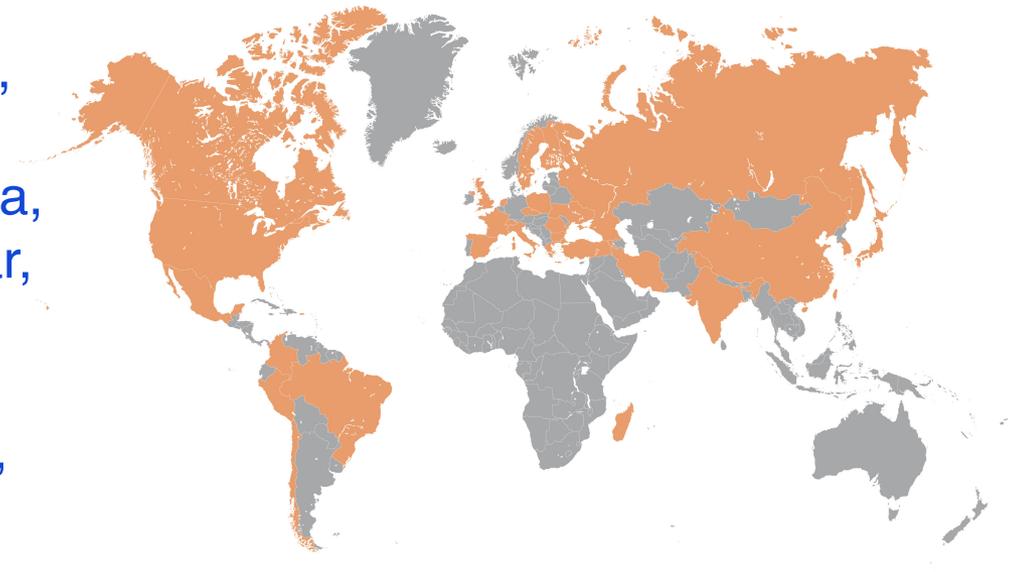
# The DUNE Collaboration

Today:

60 % non-US

960 collaborators from 163 institutions in 31 nations

Armenia, Brazil, Bulgaria,  
Canada, CERN, Chile, China,  
Colombia, Czech Republic,  
Finland, France, Greece, India,  
Iran, Italy, Japan, Madagascar,  
Mexico, Netherlands, Peru,  
Poland, Romania, Russia,  
South Korea, Spain, Sweden,  
Switzerland, Turkey, **UK**,  
Ukraine, USA



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Switzerland, Turk  
Ukraine, U



Foresee DUNE Near Detector as a broad international partnership

# 2. ND Strategy

# Strategy for Near Detector

- **We are at an earlier stage compared to the FD**
  - A number of options have been considered
- **Options: FGT, HP-TPC, LAr-TPC or a hybrid system or**
  - Fine-Grained Tracker (FGT) was the reference design for CD-1R
  - FGT is a good option, but pre-dates the DUNE collaboration
  - In **2017**, the **international DUNE collaboration** needs to **come together** to **agree a concept for the ND**
  - Once agreed, look to build matrix of ND responsibilities
- **Design can not be decoupled from \$\$\$\$**
  - Any ND concept needs to have a plausible funding model
  - Shouldn't forget that the ND is a big project in itself, need multi-national contributions

# Strategy for Near Detector

- **We are at an earlier stage compared to the FD**
  - A number of options have been considered
- **Options: FGT, HP-TPC, LAr-TPC or a hybrid**
  - Fine-Grained Tracker (FGT) was the reference design for CD-1R
  - FGT is a good option, but needs more international collaboration
  - In **2017**, the international collaboration needs to **come together** to reach a concept for the ND
  - Once agreed, a detailed matrix of ND responsibilities
- **Decisions should be decoupled from \$\$\$\$**
  - The concept needs to have a plausible funding model
  - Don't forget that the ND is a big project in itself, need multi-national contributions

**To meet the 2017 goal:  
DUNE management launched the ND Concept Study**

# 3. ND Concept Study

# Near Detector Concept Study

- **Charge:**

- Develop a proposal for a DUNE collaboration near detector **concept** by the end of **2017**

- **Study should:**

- Ensure that the proposed near detector concept **meets the requirements of the primary scientific goals of DUNE.**
- Assume a single near detector hall of a **similar to the CD-1-R design**, located at a distance of between **360 m and 575 m** from the target.
- Present a **plausible funding model** for the proposed concept, based on the interests and likely contributions to the detector construction from the international collaboration
- Focus solely on the design of the Near Detector; the scope of the study does not extend to the design of the LBNF near site facility

# Timeline

- **Major milestones/steps**

- Mar 2017: **3-day DUNE ND Workshop 27<sup>th</sup>-29<sup>th</sup> March at FNAL**
  - **open to all interested parties, not just DUNE collaboration**
- May 2017: agree on 2 [or 3] options to pursue
- Jun 2017: **3-day DUNE ND Workshop** to review and document pros/cons of each option and **assumed funding model**
- Aug 2017: presentation of options at collaboration meeting and possible down select
- By the end of 2017: **concept agreed by collaboration**

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- Early 2018: **“Expressions of Interest” in ND construction**
    - **start to identify institutional/national responsibilities**
  - By the end of 2018: **ND CDR (could be updated FGT CDR)**
  - By early of 2020: **ND TDR for CD-3C review in August**

ND Concept Study

ND Design

# 4. Approach

# How to converge on a concept

- **Needs to be a collaborative effort**
  - not a shoot out
- **Not time for multiple full MC simulations**
  - but have a number of tools in place (from ND task force):
    - MC simulations of FGT, LAr-TPC, HP-GAr-TPC
    - Some reconstruction tools
    - Fitting technology (VALOR)
- **Need to base choices on a number of approaches**
  - identification of key measurements
  - VALOR-style fits
  - Experience
- **Keep in mind \$\$\$ and likely contributions/interests**

All have  
merit

# Detector options

- **Two basic detector “approaches”**
  - LAr-TPC
    - Functionally the same as the FD
  - Fine Grained Tracker (FGT) = tracker, calorimeters, ...
    - Constrain flux/cross sections through highly-capable system
- **Could combine the two approaches in hybrid detector**
- **Then there are multiple options for FGT technologies**
  - e.g. Tracker:
    - Straw tubes (e.g. NOMAD)
    - Gaseous TPC (T2K, HP-GAr-TPC)
    - Scintillator strips (e.g. MINERVA)
- **Don’t forget the magnet system**
- **Don’t forget pile-up of many  $\nu$  interactions**

# Limiting the parameter space

- Probably three basic options

- LAr-TPC



- FGT



With technology options

- Hybrid



Engineering challenges:  
cryostat, magnet system

- Can we quickly limit this parameter space?

# 5. Summary

# Summary

- **Need an agree DUNE ND concept by end of 2017**
  - With a plausible funding model
- **Created the ND Concept Study to meet this goal**
  - Challenging timeline, so need to remain laser focused
- **An extremely interesting/challenging study**
  - Generating a lot of interest
  - To succeed, we will need to work effectively together
- **Should be a lot of fun...**

# Questions?